Dolomitization of the Mississippian Leadville Reservoir at Lisbon Field, Paradox Basin, Utah

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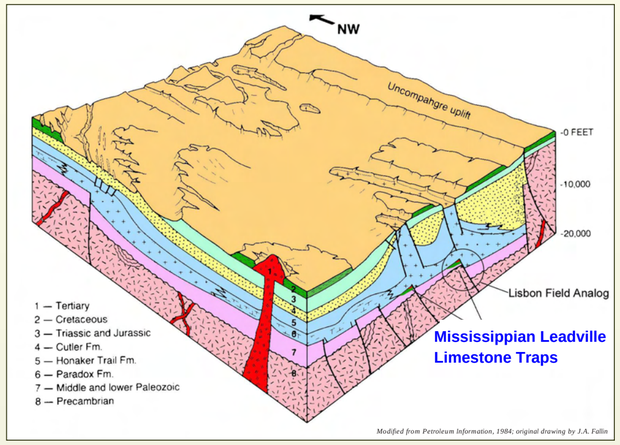
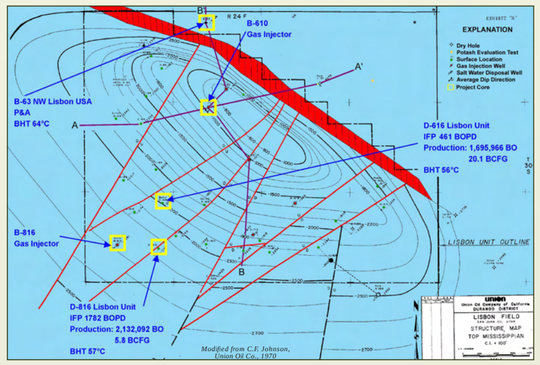
The Mississippian Leadville Limestone in Lisbon field of the northern Paradox Basin, Utah, has produced over 53.1 MMBO and 845 BCFG. The trap is an elongate, asymmetrical, northwest-trending anticline with nearly 600 m of structural closure. The field is bounded on its northeast flank by a major, basement-involved normal fault with nearly 760 m of displacement. In addition, multiple northeast-trending normal faults dissect the Leadville reservoir into segments. Several of the best producing wells are located close to these faults.

The Leadville Limestone was deposited as an open-marine, carbonate-shelf system highlighted with crinoid banks, peloid / oolitic shoals, and small Waulsortian mounds. Two major types of dolomite have been observed: (1) tight “stratigraphic” dolomite consisting of very fine grained (<5 µm), interlocking crystals that faithfully preserve depositional fabrics; and (2) porous, coarser (>100-250 µm), rhombic and saddle crystals that discordantly replace limestone and earlier “stratigraphic” dolomite. Predating or concomitant with late dolomite formation are pervasive leaching episodes that produced vugs and extensive microporosity. Solution-enlarged fractures and autobreccias are also common. Pyrobitumen and sulfide minerals appear to coat most crystal faces of the rhombic and saddle dolomites.

Stable carbon and oxygen isotope data indicate that all Lisbon Leadville dolomites were likely associated with brines whose composition was enriched in ^{18}O compared with late Mississippian seawater. Oxygen isotope data constrain temperatures of the second dolomitizing event to ~90°C. Fluid inclusions in calcite and dolomite display variable liquid to vapor ratios suggesting reequilibration at elevated temperatures. Fluid salinities exceed 10 weight percent NaCl equivalent.



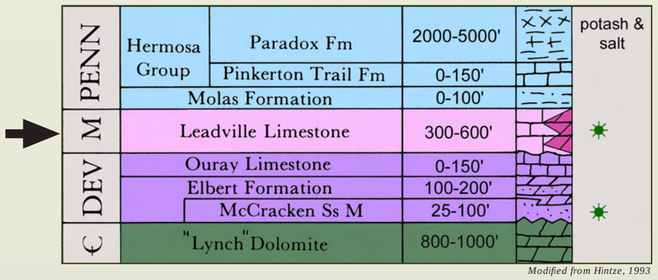
Block diagram showing the generalized nature of basement-involved faulting in Leadville fields like Lisbon in the northeastern Paradox Basin.



Structure map of Lisbon field. The field is an elongate, asymmetrical, NW-trending anticline with ~ 2000 ft (600 m) of structural closure. The field is bounded on its NE-flank by a major, basement-involved normal fault (in red) with >2500 ft (760 m) of displacement. Note that the multiple, NE-trending faults dissect the Leadville reservoir into several segments. Some of the best producing wells (e.g. cored wells D-616 and D-816) are located close to these faults. The cored wells used in this study are shown as □s.

Stratigraphic Column of the Paleozoic Section

Paradox Fold and Fault Belt



Modified from Hintze, 1993

Cum Production thru 1/05

1.6 MMBO
11.7 BCFG

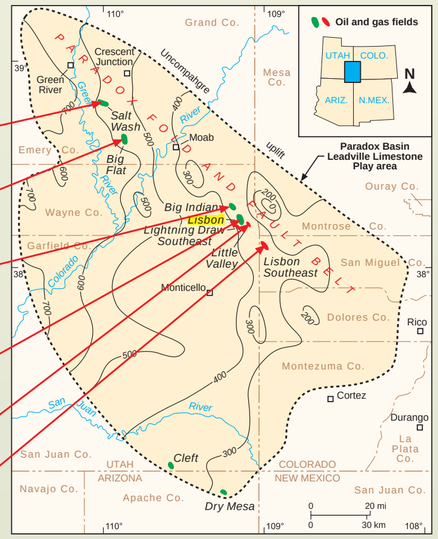
83,469 BO
0.052 BCFG

178,160 BO
26.4 BCFG

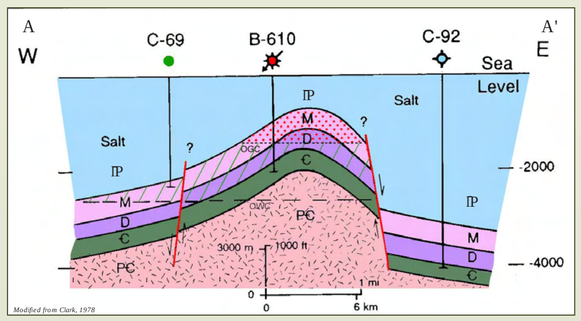
Lisbon Field
51.1 MMBO
774 BCFG

164,922 BO
16.2 BCFG

8,819 BO
16.1 BCFG



Regional map showing productive fields in the Leadville Limestone within the Fold and Fault Belt of the Paradox Basin. Lisbon field has the largest oil and gas accumulation to date.



A very generalized structural W-E cross section of Lisbon field. Note the juxtaposition of the Mississippian (M) section against the Pennsylvanian (ℙ) section evaporates (salt).